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However, antedating even Bowring, the synchronous flashing of fireflies on the Meinam River had been described by another. In 1690, Engelbert Kaempfer left Batavia as physician to the Dutch Embassy to Japan. For some unexplained reason this embassy went to Nagasaki via Siam, and describing his return down the Meinam River from Bangkok in 1690, Kaempfer wrote:

The Glowworms (Cicindalæ) represent another shew, which settle on some Trees, like a fiery cloud, with this surprising circumstance, that a whole swarm of these Insects, having taken possession of one Tree, and spread themselves over its branches, sometimes hide their Light all at once, and a moment after make it appear again with the utmost regularity and exactness, as if they were in a perpetual Systole and Diastole.[3]

Another account is taken from John Strachan's "Explorations and Adventures in New Guinea," London, 1888. This account is not strictly in line with that preceding, since it seems to be of synchronous movement rather than flashing, but at any rate it seems worth while to quote Strachan briefly. Of the man and his book no information is at hand. On page 38 he writes of fireflies observed near the Fly River:

We sat gazing enraptured on a pyramid of living light, suspended, as it were, by threads of fairy gold. On a huge black walnut [?] tree there had gathered myriads of fireflies, which, moving through the dark foliage as if to the time of some enchanter's music, presented a scene of exquisite loveliness, which it is impossible to describe. As the fairy mass revolved, now up, now down, then round as to the measured time of a dance, my companion in ecstasy exclaimed "Captain, I would work twelve months for nothing to see such a sight as this."

way for British trading ships. He ascended the Meinam River to Bangkok and on this journey witnessed the scene described above. His book was published at London in two volumes in 1857. Our reference is to Vol. I., pp. 233–234.

[3] Kaempfer, Engelbert, "The History of Japan with a Description of the Kingdom of Siam," translated by John Caspar Scheuchzer, 2 vols., folio, London, 1727. This is best available to the general reader in the elegant reprint in three volumes of the 1727 edition by James McLehose and Sons, Glasgow, 1906. Our reference is to pages 78–79 of Volume I. of this edition.

The last notice that has come to light is distinctly of synchronous movement but it may not be amiss to quote it here. Burbidge on one of his trips to Kina Balu, the great mountain of Borneo, found the natives of Kalawat, a village near its base, raising bees in hives of hollow tree trunks set under the projecting roofs of their huts. Of these bees, Burbidge says:

The kind of bee kept is very small, much smaller than that common in England, and I was much struck at the peculiar manner in which they wriggle their bodies simultaneously as they congregated in groups on the hive near the entrance.

The above accounts are those that have been found in the course of reading for other ends, but it is more than likely that a systematic search through large numbers of books of travel in the East Indies would bring to light other accounts. At any rate those given indicate that there is a "literature" even though small of this remarkable phenomenon.

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SPECIAL ARTICLES

THE ORIGIN OF NERVE CELL PIGMENTS

The determination of the origin of the two recognized pigments of the nerve cell, the melanin and the lipochrome, has equal application to other somatic cells and correlates their normal and abnormal occurrence. The subject is therefore one of general biologic interest.

The melanin pigment is produced by functional depression of some duration in any cells. It has been fully excluded experimentally from normal function and overfunction, and also from the natural senescence which ultimately results from function (senility of excitation). In short, the nerve cell by its specific differentiation is never hampered in its normal processes by the permanent accumulation of waste products of metabolism.

The histogenesis of the melanin is from nuclear material, both intranuclear and the

chromidial apparatus, or the so-called Nissl substance. It is a true metabolic pigment.

The genesis of the melanin in depression explains satisfactorily its occurrence in conditions of frank disease as well as in abnormal physiological conditions. It happens in disease because the majority of abnormal stimuli are essentially depressant. Melanin is also an almost invariable concomitant of old age. Recognizing the dual forms of senility, senility of depression and senility of excitation, the melanin is introduced by depression, which is an almost inevitable factor in the production of the combined state as it occurs in an organism under ordinary conditions. In the separate experimental production, pigment is the most concrete point of difference between the two forms of senility.

Of particular interest to anatomists is the exploding of the tradition that melanin pigment is a natural structural constituent of certain nerve cells. Such old terms as substantia nigra and locus cæruleus apparently have given this idea its greatest plausibility. Also the bulk of human anatomical material is from old or diseased individuals. Still no two investigators have ever agreed, either on its time of development, or on the places of its consistent location. As a matter of fact, the melanin may be entirely absent from an adult nervous system, and even if present in some cells of a part, it may be absent in others. Such pigment-free animals are however scarce, for few have escaped depression. Extending this negative deduction to man, the cells supposed to be pigmented are the most obviously homologous with those of lower animals naturally pigment free, and it would be a most unique anomaly if man's differentiation alone should endow him with the useless.

The lipochrome, or as it has been more commonly designated in doubt of its origin, the fat-holding or fat-combined pigment, has been the object of more active investigation and discussion in recent years. Its characteristic is its reaction to the fat stains, Sudan III. and scarlet red. The prevailing opinions have been either that it is some sort of a by-product of cell metabolism, an "Abnutzung" or "wear-and-tear" pigment, as designated by Lubarsch, or that it is a more specific product of fat or fatty acid metabolism, the lipofuscin of Borst and Hueck.

The lipochrome turns out to be an exogenous pigment derived from the carotinoid pigments, namely, the carotin and xanthophyll of plants, which are ingested with the food.

It might seem surprising that so direct a connection has escaped identification. It has not escaped a surmise, as the original transferrence of the word lipochrome from botany testifies, but the difficulty was that certain of the earlier microchemical tests for lipochrome in plants failed in their application to animal tissues. The development of the chemistry of the pigments is bringing a progressive identification between plants and animals. The identification started with the isolation in crystalline form of xanthophyll from the yolk of the hen's egg and of carotin from the corpus luteum by Willstätter and Escher.

The knowledge of the relation of these pigments to animal metabolism has been extended chiefly by Palmer and Eckles and later by Palmer alone. They have shown that the natural yellow pigment of the milk fat, body fat, corpus luteum and blood serum of the cow is identical with carotin, while xanthophyll predominantly, with some carotin, colors the egg yolk, body fat and blood serum of the hen. Further Palmer has demonstrated a remarkable species difference. Species with colored fat, such as the cow, horse and hen, carry the pigments in the blood serum; species with colorless fat, such as sheep, swine and goats, do not carry the pigments in the blood serum under the most favorable conditions.

Palmer is also carrying on some conclusive feeding experiments on chickens. Chickens deprived from birth of carotinoid pigments show absence of the yellow pigment in their skin, fat, egg yolk and blood serum. Given the pigments in their food, the color is restored. If any fowl, yellow from its natural food, be deprived of pigment, the color fades, though the process takes some months.

Such findings so aptly provided for an intracellular occurrence of lipochrome that the working hypothesis for the nerve cell was based on them. The point that first focused our attention on the probable carotinoid identity of nerve cell lipochrome was its absence in the rabbit and dog. The rabbit and dog have colorless fat. Man and cattle, known to show intracellular lipochrome, have colored fat.

Verification was first sought in the chicken. With the use for the most part of Palmer's chickens above described, two series were run, the one lacking carotinoid containing food from birth, the other carotinoid fed. The carotinoid feeding ranged from a one week's introduction in a bird hitherto carotinoid free to a lifelong natural pigment food in others. In one half of the chickens of both series the factor of depression by heat, phosphorus, morphine or a rice flour diet was introduced to cover the side of disease.

The results were uncomplicated. Both normal and depressed chickens on any carotinoid diet showed the presence of the characteristic yellow pigment in all nerve cells. The carotinoid-free chickens lacked such a pigment in demonstrable amount.

However, this physiological demonstration of the introduction of carotinoid pigment demands for completeness the support of micro-chemistry. The question at once arises if the pigment introduced in nervous and other body tissues is identical with the lipofuscin, "wear-and-tear," fat-holding pigment described for the nerve and other somatic cells as specific. While it is true that the micro-chemistry of the lipochrome pigments is superficial, which is the reason that the analysis by that means has hitherto failed, yet it must be emphasized that it has become quite sufficient to demonstrate this identity. The application of this chemistry was more simple in our problem when following a means of providing or withdrawing the pigment at will. The yellow pigment introduced in nerve cells and the chicken skin, and the pigment of the carrot in frozen sections give the fat stains, the oxidation and decolorization by hydrogen peroxid and ferric chlorid, the fat stains after oxidation, and the rapid solubilities in fat solvents in common with a supposed lipofuscin; while the most characteristic test for lipofuscin, the Nile blue stain of Hueck, equally applies to known lipochrome before and after its oxidation. This supposed metabolic pigment of the nerve cell is then identical with a true lipochrome.

Finally in corroboration of the species difference in the transferrence of the carotinoid pigment from plants, the cow as well as the chicken exhibits it in nerve cells, while swine with their colorless fat line up with the rabbit and dog in a complete absence. Man, who is best known to exhibit lipochrome, is also known to carry carotinoids in his blood serum, and has colored fat. The consistency is complete.

The lipochrome pigment of the nerve cell is therefore a plant carotinoid, derived from the food, but limited to such species as carry the carotinoids in the blood serum. The conception of it as a "wear-and-tear" pigment falls to the ground with its demonstration as an exogenous and fortuitous pigment. The melanin of the nerve cell is a true metabolic pigment, derived from nuclear materials and produced by chronic depression. Because of this, the conception of a "wear-and-tear" pigment is to be transferred to the melanin, as conditioned by agencies without the cell, with a restriction to the abnormal.

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SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter